

FINAL TECHNICAL REPORT

**A COMPREHENSIVE STUDY OF THE EASTERN TENNESSEE SEISMIC ZONE  
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### Abstract

An investigation of the seismic velocity structure and potential field anomalies associated with the eastern Tennessee seismic zone (ETSZ) was initiated during the grant period. The large, linear extent of the ETSZ (300 by 50 km) and its proximity to a prominent potential field anomalies (e.g. the New York - Alabama (NY-AL) magnetic lineament) implies an association with a major crustal structural boundary. The framework for a seismotectonic model for the ETSZ was laid in this investigation by inverting over one thousand P-wave arrival times from local events recorded by seismic stations comprising the Southern Appalachian Cooperative Seismic Network for one and three dimensional crustal velocity models. The one-dimensional inversion stabilized after three iterations. After the first iteration, thirteen events were eliminated, four were eliminated after the second, and two were eliminated after the third. Resolution was not high in the first (top) layer which extended to a depth of 5.7 km but excellent resolution was obtained in the two lower layers (0.96 in layer two and 0.99 in layer three). Velocity increased in the second layer (depth 5.7 to 14.7 km) by 2.8% relative to the starting model while velocity decreased in the third layer (depth 14.7 to 50.7 km) by 1.7%. The primary effect on event relocations was to change focal depth.

Interpretation of aeromagnetic and potential field anomalies was also initiated. Preliminary forward modeling suggests that the prominent, linear aeromagnetic and gravity anomalies that parallel the ETSZ along its northeastern boundary are produced by magnetic susceptibility and density contrasts located below the décollement. This result was anticipated and is consistent with results obtained previously. Preliminary interpretation of gravity profiles does not support the presence of mafic bodies as the source for the NY-AL lineament. The gravity profiles suggest the presence of relatively low density rock northwest of the NY-AL lineament and relatively high density rock southeast of the lineament. Preliminary interpretation of potential field data is encouraging and suggests that these data can be used in conjunction with crustal velocity inversions to derive a viable seismotectonic model for the ETSZ.